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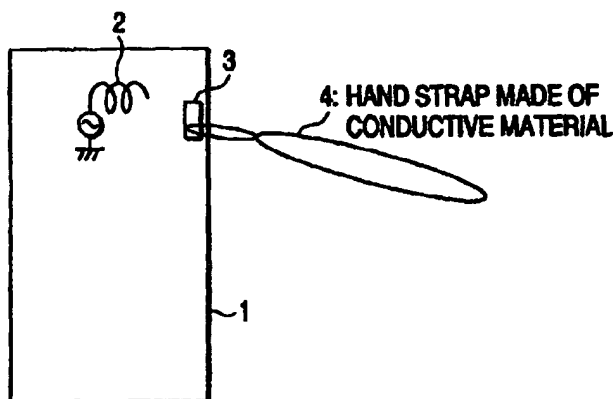
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(54) **Mobile wireless device**

(57) The mobile wireless device of the present invention comprises: the wireless device main body 1; the antenna element 2 provided in the case; the hand strap connection portion 3 to connect the hand strap 4 to the vicinity of the antenna element 2; and the hand strap 4 which is made of conductive material and is

formed into a ring shape. As the result, when the hand strap 4 which is made of conductive material and is formed into a ring shape, is attached, the hand strap 4 and the antenna element 2 are electro-magnetically coupled, and thereby, the antenna has a high gain.

**FIG. 1**



## Description

### BACKGROUND OF THE INVENTION

[0001] The present invention relates to a mobile wireless device, and particularly to a mobile wireless device structured in such a manner that a hand strap and a built-in antenna element are electro-magnetically coupled with each other and form a high gain antenna.

[0002] Fig. 8 is a view showing the structure of the conventional mobile wireless device. In Fig. 8, the mobile wireless device comprises a wireless device main body 21, antenna element 22, hand strap connection portion 23, and hand strap 24.

[0003] In Fig. 8, the hand strap 24 is structured by either one of fiber fabric or synthetic resin, or composition of them, and is formed into a ring shape.

[0004] In the conventional mobile wireless device, the hand strap 24 is, as described above, structured into a ring-like one formed of any one of, or composite of fiber fabric, fiber knitted goods, or synthetic resin, and does not affect the electric characteristic of the antenna element 22 structured inside the wireless device main body 21. Accordingly, when a size of the antenna element 22 is reduced, the gain of the antenna is deteriorated, which is a problem.

### SUMMARY OF THE INVENTION

[0005] The present invention is attained to solve the above-described problem, and an object of the present invention is to provide a mobile wireless device in which the hand strap and the antenna element are electro-magnetically coupled, and a high gain antenna is obtained.

[0006] In order to solve the above-described problem, in a mobile wireless device, the present invention is characterized in that an antenna element is provided inside a case of a wireless device main body, a hand strap connection portion is provided in the vicinity of the antenna element, and a hand strap which is made of conductive material and formed into a ring shape, is attached to the hand strap connection portion.

[0007] Accordingly, according to the present invention, an effect that the hand strap and the built-in antenna element are electro-magnetically coupled, thereby the antenna can have a high gain, is obtained.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

Fig. 1 is a block diagram showing the structure of a mobile wireless device in the first embodiment of the present invention.

Fig. 2 is a graph showing the length of a hand strap and a change of gain at the time of use of the human body, according to the first embodiment of

the present invention.

Fig. 3 is a block diagram showing the structure of the mobile wireless device in the second embodiment of the present invention.

Fig. 4 is a schematic view showing the structure of a hand strap of the mobile wireless device in the third embodiment of the present invention.

Fig. 5 is a schematic view showing the structure of a hand strap of the mobile wireless device in the fourth embodiment of the present invention.

Fig. 6 is a schematic view showing the structure of a hand strap of the mobile wireless device in the fifth embodiment of the present invention.

Fig. 7 is a schematic view showing the structure of a hand strap of the mobile wireless device in the sixth embodiment of the present invention.

Fig. 8 is a block diagram showing the structure of the conventional mobile wireless device.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] In the invention described in Aspect 1 of the present invention is, in a mobile wireless device, an antenna element is provided inside a case of a wireless device main body, a hand strap connection portion is provided in the vicinity of the antenna element, and a hand strap which is made of conductive material and formed into a ring shape, is attached to the hand strap connection portion, therefore, an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby the antenna can have a high gain, is obtained.

[0010] Further, in the invention described in Aspect 2, in a mobile wireless device, an antenna element is provided inside a resin case of a wireless device main body, a hand strap connection portion made of the same resin material as the resin case is provided in the vicinity of the antenna element, and a hand strap which is made of conductive material and formed into a ring shape, is attached to the hand strap connection portion, therefore, the structure of the connection portion is simplified, and an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby the antenna can have a high gain, is obtained.

[0011] Further, in the invention described in Aspect 3, in a mobile wireless device, an antenna element is provided inside a resin case of a wireless device main body, a hand strap connection portion made of the same resin material as the resin case is provided in the vicinity of the antenna element, and a hand strap, in which a fiber cord inside of which a conductive metallic wire is passed is formed into a ring shape, is attached to the hand strap connection portion, and therefore the conductivity can be provided to the strap, and an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby the antenna can have a high gain, is obtained.

[0012] Further, in the invention described in Aspect 4, in a mobile wireless device, an antenna element is provided inside a resin case of a wireless device main body, a hand strap connection portion made of the same resin material as the resin case is provided in the vicinity of the antenna element, and a hand strap, in which a fiber cord on which conductive metal plating is conducted is formed into a ring shape, is attached to the hand strap connection portion, and therefore, the conductivity can be provided to the strap, the hand strap can have flexibility, and an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby the antenna can have a high gain, is obtained.

[0013] Further, in the invention described in Aspect 5, in a mobile wireless device, an antenna element is provided inside a resin case of a wireless device main body, a hand strap connection portion made of the same resin material as the resin case is provided in the vicinity of the antenna element, and a hand strap, in which a cord formed by passing a fiber cord, on which conductive metal plating is conducted, through the inside of a fiber cord on which conductive metal plating is not conducted, is formed into a ring shape, is attached to the hand strap connection portion, and therefore, the conductivity can be provided to the strap, the hand strap can have flexibility, the beautiful external view can be obtained, and an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby the antenna can have a high gain, is obtained.

[0014] Further, in the invention described in Aspect 6, in a mobile wireless device, an antenna element is provided inside a resin case of a wireless device main body, a hand strap connection portion made of the same resin material as the resin case is provided in the vicinity of the antenna element, and a hand strap, in which a cord formed by attaching a fiber cord, on which conductive metal plating is conducted, onto the rear side of a fiber cord on which conductive metal plating is not conducted, is formed into a ring shape, is attached to the hand strap connection portion, and therefore, the conductivity can be provided to the strap, the hand strap can have flexibility, the beautiful external view can be obtained, and an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby the antenna can have a high gain, is obtained.

[0015] Referring to the drawings, embodiments of the present invention will be described below.

(First embodiment)

[0016] Fig. 1 shows the structure of the mobile wireless device in the first embodiment of the present invention, and in Fig. 1, the mobile wireless device comprises: the wireless device main body 1; the antenna element 2 provided in the case; the hand strap connection portion 3 to connect the hand strap 4 to the vicinity of the antenna element 2; and the hand strap 4

which is made of conductive material and is formed into a ring shape.

[0017] In the structure in such the first embodiment, when the length of the hand strap L and a change of the antenna gain at the time of use of the human body, are measured, the following result can be found: as shown in Fig. 2, when the electrical length of the strap (the length having the conductivity) is 150 mm, the gain of the antenna is improved by about 15 dB.

[0018] From this result, when the hand strap 4 which is made of conductive material and is formed into a ring shape, is attached, the hand strap 4 and the antenna element 2 are electromagnetically coupled, thereby, the gain of the antenna can be increased.

(Second embodiment)

[0019] Fig. 3 shows the structure of the mobile wireless device in the second embodiment of the present invention, and in Fig. 3, the mobile wireless device comprises: the wireless device main body 1; the antenna element 2 provided in the resin case of the wireless device main body 1; the hand strap connection portion 33 to connect the hand strap 4, made of the same resin material as the resin case of the wireless device main body, to the vicinity of the antenna element 2; and the hand strap 4 which is made of conductive material and is formed into a ring shape. As the result, when the hand strap connection portion 33 is structured by the same resin material as the resin case, the structure becomes simple, and further, when the hand strap 4 which is made of conductive material and is formed into a ring shape, is attached, the hand strap 4 and the antenna element 2 are electro-magnetically coupled, thereby, the antenna has a high gain.

(Third embodiment)

[0020] Fig. 4 shows the structure of the hand strap of the mobile wireless device in the third embodiment of the present invention, and the structure not shown in Fig. 4 is the same as that in the second embodiment. In Fig. 4, the hand strap 34 is a hand strap in which a fabric cord, inside of which a conductive metallic wire is passed, is formed into rig-like. As the result, when the fabric cord, inside of which a conductive metallic wire is passed, is used, the conductivity can be provided onto the strap 34, and when the conductive hand strap 34 is attached, the hand strap 34 and the antenna element are electro-magnetically coupled, and thereby, the antenna has a high gain.

(Fourth embodiment)

[0021] Fig. 5 shows the structure of the hand strap of the mobile wireless device in the fourth embodiment of the present invention, and the structure not shown in Fig. 5 is the same as that in the second embodiment. In

Fig. 5, the hand strap 35 is a hand strap in which a fabric cord, on which conductive metal plating is conducted, is formed into rig-like. As the result, when the fabric cord, on which conductive metal plating is conducted, is used, the conductivity can be provided onto the strap 35, and the strap 35 has the flexibility, and when the conductive hand strap 35 is attached, the hand strap 35 and the antenna element are electro-magnetically coupled, and thereby, the antenna has a high gain.

(Fifth embodiment)

[0022] Fig. 6 shows the structure of the hand strap of the mobile wireless device in the fifth embodiment of the present invention, and the structure not shown in Fig. 6 is the same as that in the second embodiment. In Fig. 6, the hand strap 36 is a hand strap in which a cord formed by passing the fabric cord, on which conductive metal plating is conducted, through the inside of the fabric cord on which conductive metal plating is not conducted, is formed into a ring shape. As the result, when the cord 36 formed by passing the fabric cord, on which conductive metal plating is conducted, through the inside of the fabric cord on which conductive metal plating is not conducted, is used, the conductivity can be provided onto the strap 36, the strap 36 can have the flexibility, and the beautiful external view can be obtained, and in addition to that, when the conductive hand strap 36 is attached, the hand strap 36 and the antenna element are electro-magnetically coupled, and thereby, the antenna has a high gain.

(Sixth embodiment)

[0023] Fig. 7 shows the structure of the hand strap of the mobile wireless device in the sixth embodiment of the present invention, and the structure not shown in Fig. 7 is the same as that in the second embodiment. In Fig. 7, the hand strap 37 is a hand strap in which a cord formed by adhering the fabric cord, on which conductive metal plating is conducted, onto the rear side of the fabric cord on which conductive metal plating is not conducted, is formed into a ring shape. As the result, when the cord 37 formed by adhering the fabric cord, on which conductive metal plating is conducted, onto the rear side of the fabric cord on which conductive metal plating is not conducted, is used, the conductivity can be provided onto the strap 37, the strap 37 can have the flexibility, and the beautiful external view can be obtained, and in addition to that, when the conductive hand strap 37 is attached, the hand strap 37 and the antenna element are electro-magnetically coupled, and thereby, the antenna has a high gain.

[0024] As can clearly be seen from the above description, according to the first invention, when the hand strap which is made of conductive material and formed into a ring shape, is attached, an effect that the hand strap and the antenna element are electro-mag-

netically coupled, thereby, the antenna has a high gain, is obtained.

[0025] Further, according to the second invention, when the hand strap connection portion is structured by the same resin material as the case, the structure becomes simple, and when the hand strap which is made of conductive material and formed into a ring shape, is attached, an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby, the antenna has a high gain, is obtained.

[0026] Further, according to the third invention, when a fabric cord, through the inside of which a conductive metallic wire is passed, is used, the conductivity can be provided onto the strap, and when the conductive hand strap is attached, an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby, the antenna has a high gain, is obtained.

[0027] Further, according to the fourth invention, when a fabric cord on which conductive metal plating is conducted, is used, the conductivity can be provided onto the strap, and the hand strap can have the flexibility, and when the conductive hand strap is attached, an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby, the antenna has a high gain, is obtained.

[0028] Further, according to the fifth invention, when a cord formed by passing the fabric cord, on which conductive metal plating is conducted, through the inside of the fabric cord on which conductive metal plating is not conducted, is used, the conductivity can be provided onto the strap and the hand strap can have the flexibility, and the beautiful external view can also be obtained, and in addition to that, when the conductive hand strap is attached, an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby, the antenna has a high gain, is obtained.

[0029] Finally, according to the sixth invention, when a cord formed by attaching a fiber code on which conductive metal plating is conducted, onto the rear side of a fiber cord on which conductive metal plating is not conducted, the conductivity can be provided onto the strap and the hand strap can have the flexibility, and the beautiful external view can also be obtained, and in addition to that, when the conductive hand strap is attached, an effect that the hand strap and the antenna element are electro-magnetically coupled, thereby, the antenna has a high gain, is obtained.

FIG. 1

4: CONDUCTIVE CORD

FIG. 2

a: THE LENGTH L OF THE STRAP AND GAIN AT THE TIME OF USE OF THE HUMAN BODY  
b: LENGTH L OF THE STRAP [mm]  
c: GAIN AT THE TIME OF USE OF THE

HUMAN BODY [dB]

FIG. 3

33: THE CONNECTION PORTION OF THE  
HAND STRAP IS FORMED OF THE SAME  
RESIN

FIG. 4

34: A FABRIC CORD THROUGH THE INSIDE  
OF WHICH A CONDUCTIVE METALLIC WIRE  
IS PASSED

FIG. 5

35: A FABRIC CORD ON WHICH CONDUCTIVE  
METAL PLATING IS CONDUCTED

FIG. 6

36: A FABRIC CORD ON WHICH CONDUCTIVE  
METAL PLATING IS CONDUCTED, IS  
PASSED THROUGH THE INSIDE A FABRIC  
CORD ON WHICH CONDUCTIVE METAL  
PLATING IS NOT CONDUCTED.

FIG. 7

37: A FABRIC CORD ON WHICH CONDUCTIVE  
METAL PLATING IS CONDUCTED, IS  
ATTACHED TO THE INSIDE.

#### Claims

1. A mobile wireless device comprising:

a case of said wireless device main body;  
an antenna element provided inside said case;  
a hand strap connection portion provided in the  
vicinity of said antenna element; and  
a hand strap which is made of conductive  
material and formed into a ring shape, being  
attached to said hand strap connection portion.

2. The mobile wireless device as claimed in Claim 1,  
wherein

said case is made of resin; and  
said hand strap connection portion is made of  
the same resin material as said resin case.

3. The mobile wireless device as claimed in Claim 2,  
wherein

said hand strap, in which a fiber cord through  
inside of which a conductive metal wire passes,  
is formed into a ring shape and is attached to

said hand strap connection portion.

4. The mobile wireless device as claimed in Claim 2,  
wherein

said hand strap, in which a fiber cord on which  
conductive metal plating is conducted, is  
formed into a ring shape and is attached to said  
hand strap connection portion.

5. The mobile wireless device as claimed in Claim 2,  
wherein

said hand strap, in which fiber cord formed by  
passing a fiber code, on which conductive  
metal plating is conducted, through the inside  
of said fiber cord on which conductive metal  
plating is not conducted, is formed into a ring  
shape and is attached to said hand strap con-  
nection portion.

6. The mobile wireless device as claimed in Claim 2,  
wherein

said hand strap, in which a cord formed by  
attaching a fiber code, on which conductive  
metal plating is conducted, onto the rear side of  
said fiber cord on which conductive metal plat-  
ing is not conducted, is formed into a ring  
shape and is attached to said hand strap con-  
nection portion.

FIG. 1

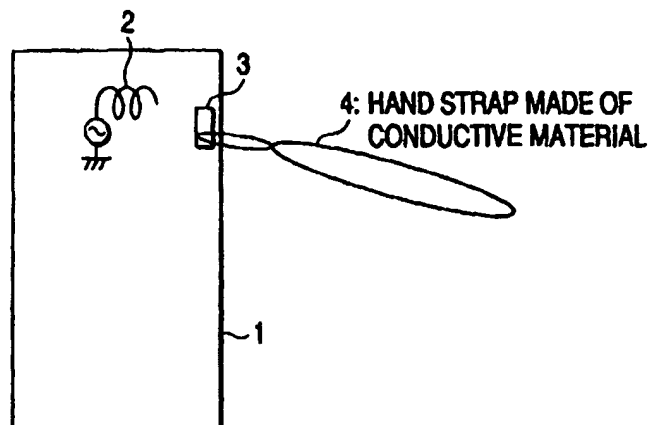
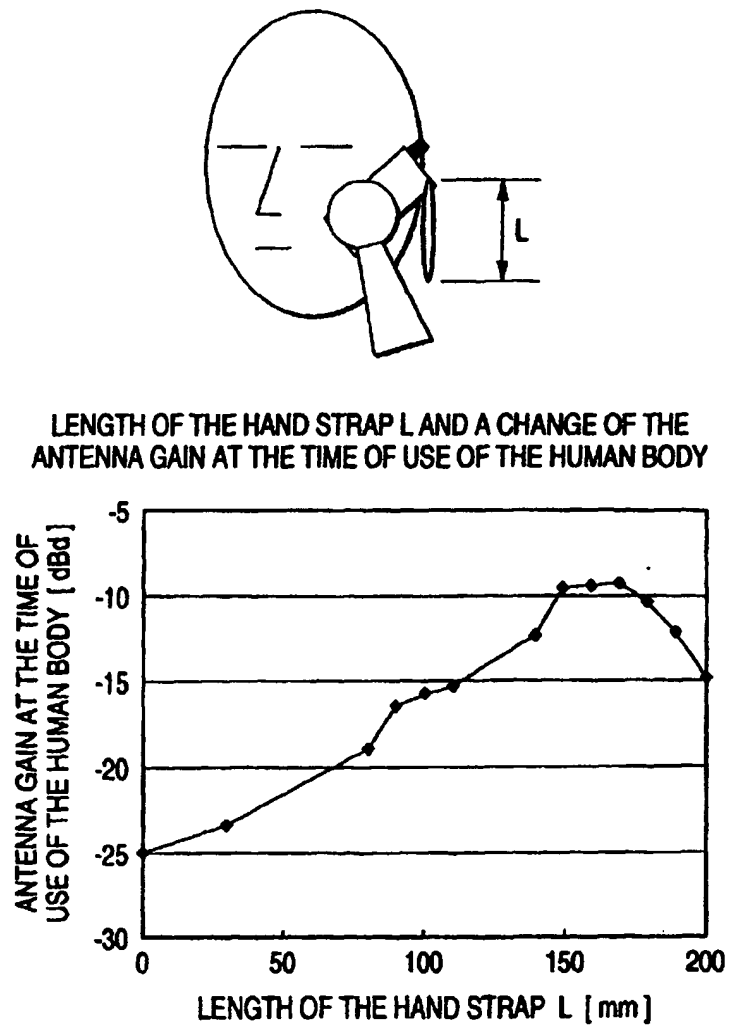
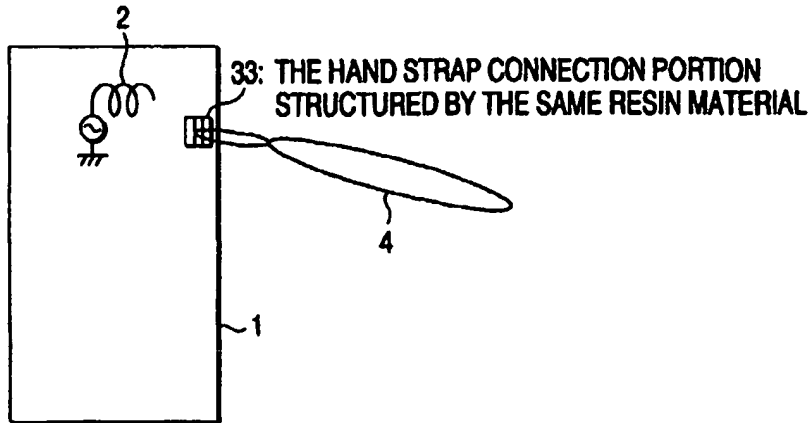


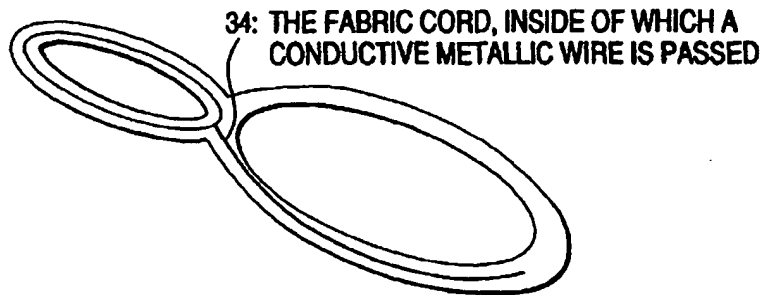
FIG. 2



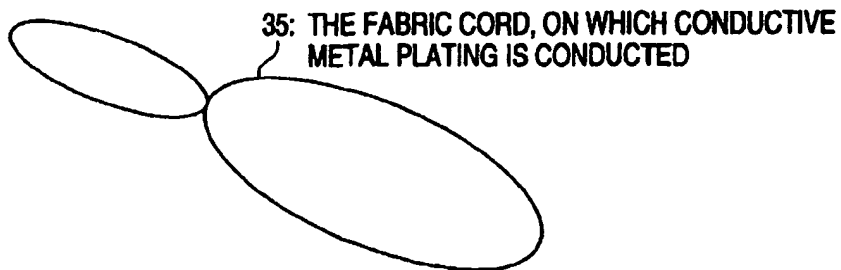
**FIG. 3**



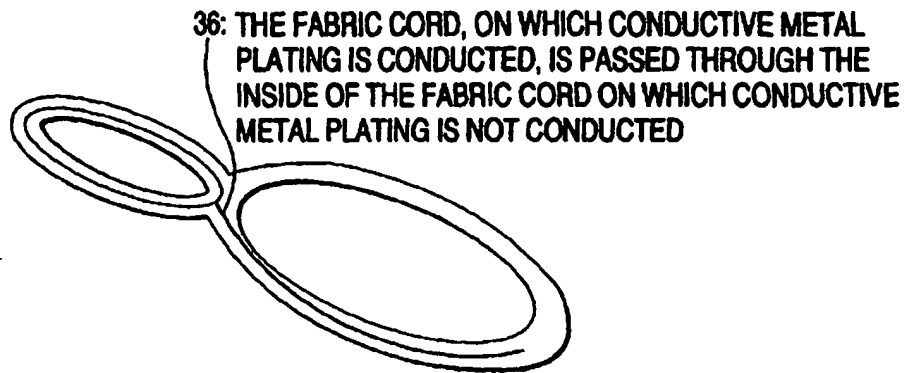
**FIG. 4**



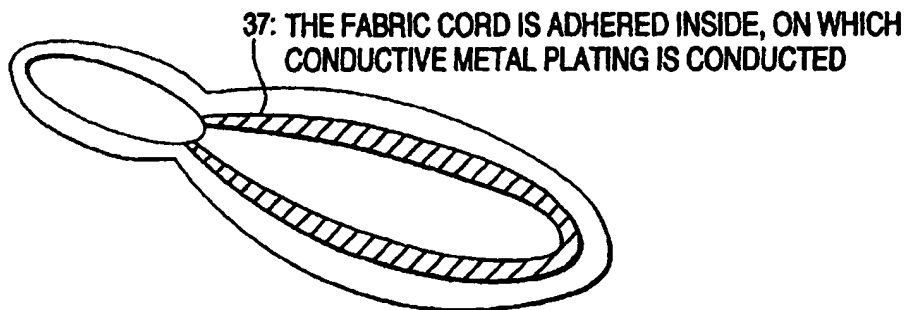
**FIG. 5**



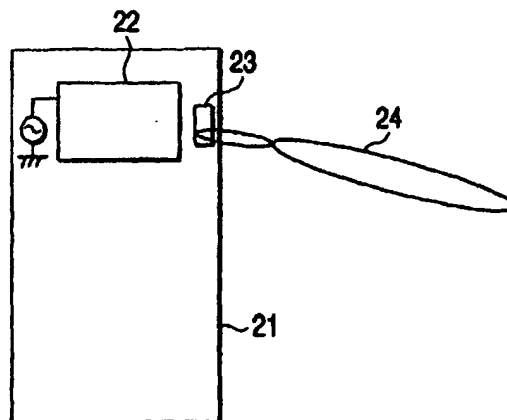
**FIG. 6**



**FIG. 7**



**FIG. 8**







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# EUROPEAN SEARCH REPORT

Application Number  
EP 99 11 9206

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 03, 28 April 1995 (1995-04-28) & JP 06 334557 A (MITSUBISHI ELECTRIC CORP), 2 December 1994 (1994-12-02) * abstract; figures 1-10 *	1-6	H0101/24
A	GB 2 248 330 A (SEEMAN DAVID WILLIAM) 1 April 1992 (1992-04-01) * the whole document *	1-6	
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 03, 27 February 1998 (1998-02-27) & JP 09 289671 A (SAITAMA NIPPON DENKI KK), 4 November 1997 (1997-11-04) * abstract; figure 2 *	1-6	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)  H01Q
Place of search <b>MUNICH</b>		Date of completion of the search <b>22 December 1999</b>	Examiner <b>Villafuerte Abrego</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EP 99 11 9206

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22-12-1999

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